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Chairmen of local committees conferring on plans for the 114th annual meeting of the AAAS, to be held in Chicago. *Standing:* W. L. Cortelyou, Roosevelt College, Finance Committee, and Jeannette Lowrey, University of Chicago, Publicity Committee. *Seated:* R. T. Van Niman, Chicago Technical Societies Council, Equipment Committee; Margaret Scriven, Chicago Historical Society, Reception and Entertainment Committee; and Hans O. Hoeppner, University of Chicago, Registration Committee (see *News and Notes*).

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Leonard A. Maynard

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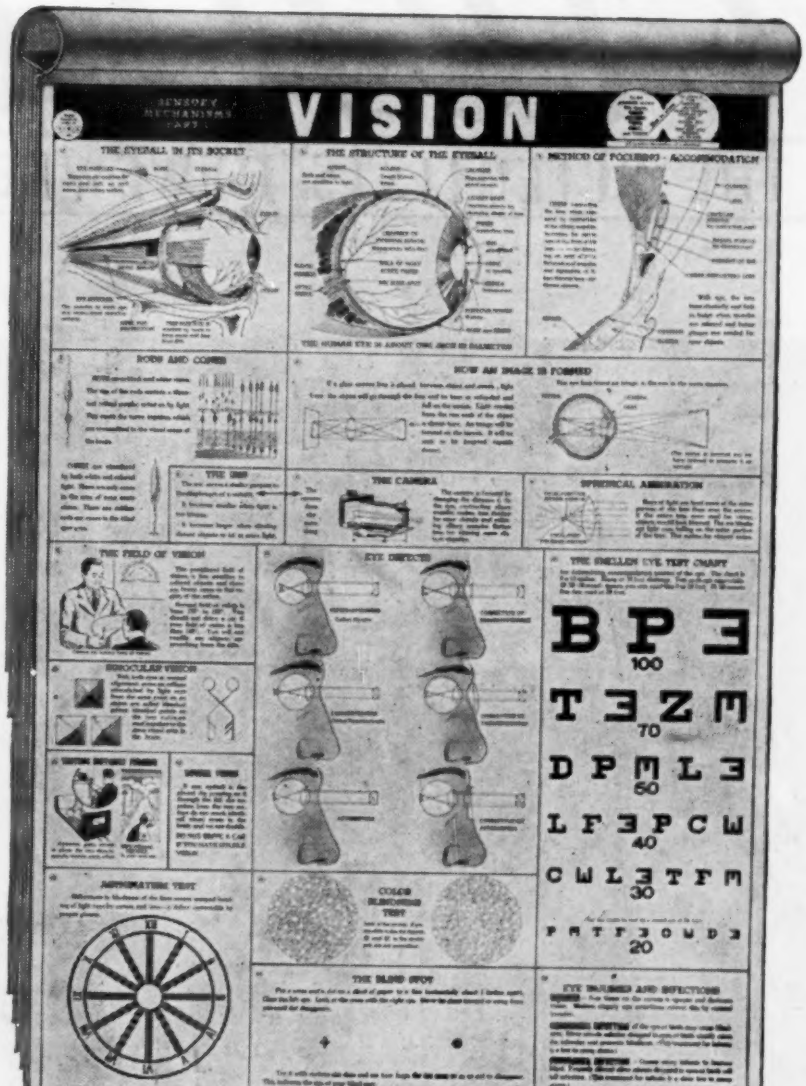

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Science

CONTENTS

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A Chemist's View of Nutrition

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OVER 150 YEARS AGO LAVOISIER, WHO is recognized as the father of the science of nutrition, stated: "La vie est une fonction chemique." Since that time chemistry has played the central role in the development of nutrition knowledge. The development has been accelerated as organic and physical chemists, as well as biochemists, have recognized nutrition as a worthy field of activity.

In 1912 the existence of the first vitamin was definitely proved—as a *something*, a quality, a property, or perhaps a substance, which some foods had and others did not. Other vitamins became thus recognized in succeeding years, but it was not until the organic chemist commenced to give these "somethings" attention that the field really moved. It was over 15 years after the first vitamin was discovered that the chemical nature of any of them was definitely established. In the succeeding years, isolation, determination of structure, and, frequently, synthesis followed increasingly closely on the biologists' discoveries. In fact, the organic chemist has assumed the role of discoverer, or at least the final arbiter, as to whether a proposed vitamin is entitled to be considered a separate entity. The elucidation of the folic acid puzzle, which has resulted from the determination of the structure of the *Lactobacillus casei* factor through analysis and synthesis, is a striking example. Synthesis, particularly on a commercial scale, has given a tremendous impetus to the advancement of vitamin research as well as to human medicine.

While chemistry is making new discoveries which may enhance the importance of nutrition, it can also play a major role in keeping nutrition practice sound. The overexploitations of the last few years, which have embarrassed the true nutrition scientist and hurt the cause of nutrition, can only be combated by clearly established facts. Optimum nutrition certainly will not be accomplished by saturating the body with a few vitamins, with lesser attention accordingly to other essential nutrients.

Nutrition deals with proteins, energy-forming nutrients, minerals, and vitamins, but these nutrients must be translated into foods. Thus, nutrition must deal with both body needs and food supplies. Chemistry is concerned all the way across the board from production through processing and storage to the home preparation of food, as well as with what happens to it inside the body. Body needs must provide the basis for determining the kinds and amounts of food supplies required, and here much more needs to be learned.

First of all, we need a better understanding of the biochemistry of body processes and, particularly, of the specific chemical reactions in the body for which certain nutrients are essential. We know that thiamine is a constituent of the enzyme, carboxylase, essential for the removal of pyruvic acid, an intermediate in carbohydrate breakdown, and thus we can relate the requirement of the vitamin to the intensity of energy metabolism. In the case, however, of vitamin D, the chemistry of which has been known for years, we can only make the general statement that it is essential for normal calcium and phosphorus metabolism. How or when it acts we do not know. Our specific knowledge of body requirements is, accordingly, much less. The same situation holds for certain other essential nutrients, both vitamins and minerals.

It is clear from discoveries to date that enzyme chemistry particularly has a lot to contribute to our knowledge of body processes and nutrient functions. Several vitamins have been recognized as a result of investigations of enzyme systems in the living cell, and such studies will continue to increase our knowledge of the most intricate metabolic processes.

Our understanding of nutritional requirements during the last half of life is much less than for the period of growth, because we know less about the tissue changes which are taking place. A child falls down, jumps up, and goes blithely on his way. An old man falls down and breaks his hip. What differences in the physicochemical structure of the bones are involved? We understand the role of nutrition in building bone during growth, but little about its possible contribution in retarding aging changes.

While it is probable that some dietary essentials remain to be discovered, much more needs to be learned regarding the quantitative requirements of the ones now known. The amounts needed to prevent and cure the physical symptoms of specific deficiencies are understood. But when we try to specify the higher levels that are desirable for optimum body functions, we approach the realm of speculation. We do not know what this optimum condition is with respect to a given nutrient and, thus, how to arrive at the quantitative requirement. The chemist must help in identifying the significant metabolic changes involved, in devising methods which can be readily ap-

An address presented before the New York Section of the American Chemical Society, December 6, 1946.

plied for detecting their abnormalities, and in ascertaining the quantitative role of specific nutrients in preventive and curative measures.

It takes around 100 mg. of vitamin C daily to keep the body saturated with this vitamin, as indicated by blood levels and urinary excretion. Yet, as little as 30 mg. appears to protect the body against any physical symptoms of scurvy. In fact, according to a preliminary report, a recently completed English study failed to find any physical signs of deficiency from feeding as little as 12 mg. over a period of a year to subjects previously on high intakes. Vitamin C is concerned, however, with the health of all tissues in the body, not merely the skin and gums which provide the external physical symptoms. In the English subjects the blood vitamin level rapidly dropped to nearly zero. What is the significance of blood level anyway, and where should it be maintained? How is it correlated with changes which affect health?

Questions of this sort need to be answered for several nutrients. The nutrition scientist has learned that it is unwise to be content with absence of physical symptoms. Further, it is wiser to specify unnecessarily high intakes than to run the risk of injury to health. But we need more exact bases for our recommendations than we now have. There is increasing evidence that for certain nutrients a limited intake may be preferable to an overgenerous one.

These questions have an important bearing on the food economy which deals with the kinds and costs of the family food, the character of the food supply needed by populations, and the plans which must be made accordingly. These economic considerations have been of paramount importance in rehabilitation activities, and the lack of more reliable bases have been a serious handicap. Economic as well as health aspects will continue to constitute important reasons for more specific knowledge in any world program such as that envisaged by the Food and Agriculture Organization.

We need new techniques for studying human metabolism directly, but a large place remains for animal studies in order to learn basic reactions with species which can be closely controlled and which are also expendable, before subjecting humans to experimental restrictions. Here, farm animals as well as laboratory animals have a place. Some of the most important discoveries affecting both human and animal nutrition have been made with farm animals—vitamin discoveries with chickens and hogs, mineral discoveries with cattle and sheep, for example. Many findings with these animals require testing for their human applications. It has been found that .1 mg. of cobalt daily makes the difference between life and death in a sheep; a lack of this minute amount was responsible for the death of tens of thousands of animals yearly before the discovery was made. This mineral is probably unimportant in human nutrition, but we are not sure about this.

Thus, in many respects, we know more about feeding farm animals than feeding people. Economic and other aspects have been studied through continuing large-scale programs in every state experiment station and in government laboratories. But, by and large, the output of basic knowledge has been limited in terms of the expenditures made because of a lack of realization by the leaders as to what chemistry and physiology might contribute and by the scientists as to the opportunities for making fundamental discoveries of importance to human health as well as to animal production.

The purified diet method has proved one of the most effective procedures in modern nutrition research, particularly as commercial sources of synthetic vitamins and amino acids have become available. Its early use with rats and dogs has now been extended to several other species, including man. With its increasing use and development, however, certain possible limitations have become evident. These are being taken account of in current research.

Amino acids are coming into increasing use in purified diets as a method of determining their quantitative requirements. Recent research, however, has raised an important question with respect to the use of amino acids to supply the entire protein component of a purified diet. It has been observed repeatedly that the growth rates obtained in experimental animals on amino acid mixtures are not as rapid as when protein of high biological value is employed. Both Woolley and Rose have recently reported evidence that certain intact proteins contained a growth factor apparently different from any of the amino acids obtained on their hydrolysis. Specifically, Woolley found that strepogenin, a peptide-like bacterial growth factor present in casein but destroyed on acid hydrolysis, was an effective supplement to a casein digest. These brief reports indicate clearly that the nutritional properties of proteins, as normally obtained in a purified state, may not reside solely in the amino acids resulting from their hydrolysis. Does the protein molecule contain other essential structures besides amino acids, or do proteins, as normally purified, contain extraneous growth factors bound to them?

Purification processes change the physical nature of proteins as they occur in foods. May some of the extreme procedures change the nutritive value of naturally-occurring protein molecules and thus limit the application of the results obtained with purified diets?

Clearly, one of the differences between purified diets and those made up of natural foods lies in their different effects on vitamin synthesis in the intestine—a process now recognized to be important in several species, including man. Different carbohydrates, originally considered interchangeable in purified diets, have been found to exert variable effects on vitamin synthesis in the intestinal tract and thus on the over-all result obtained. For example, lactose and starch are more effective than

sucrose in promoting riboflavin synthesis. The recent findings with purified diets, that tryptophane lessens the dietary need for nicotinic acid, have been explained on the basis that tryptophane promotes the intestinal synthesis of the vitamin, perhaps as a precursor. While this tryptophane-nicotinic acid relation has been suggested as a reason for the pellagra-promoting effect of corn, the finding of Woolley that corn contains an antivitamin which competes with nicotinic acid provides another explanation. This whole subject of antivitamins should intrigue the chemist.

Whatever may be the explanation of some of these recent findings with purified diets, it must be recognized that the results obtained with large amounts of pure nutrients may be quite different from those obtained with the natural foods of which our diets are composed. The basic value of the purified diet method is not thus impaired, but interpretations must be reconsidered accordingly.

The body requires countless organic compounds for its metabolism. Most of them are supplied by the proximate principles and their metabolites. Others are not so supplied and become separate dietary essentials, except as some of them are synthesized in part or in whole in the intestine. These generalizations we understand, but the details which influence both quantitative and qualitative dietary requirements require much more study. What are the precursors of the nonessential amino acids, and under what conditions may they be deficient in the diet? What is the precursor of vitamin C in the diets of those species which synthesize it, and is this precursor always adequately supplied?

All of these studies of body needs must be paralleled by equally important ones dealing with the food supply. There are still many nutritive factors which must be tagged chemically, and quantitative methods for their determination must be worked out. The latter job cannot be shifted entirely to the microbiologist, despite the remarkable contributions he is making. Take the case of vitamin B_6 as an example. After pyridoxine was isolated as this vitamin and after much was learned about its distribution in foods, two more active compounds, the aldehyde and the amine, were discovered and found to behave differently to the test organisms used in assaying pyridoxine. New active forms are being found for several of the vitamins. Chemical methods, as well as biological studies with appropriate higher animal species, must continue to be used in the development of suitable microbiological procedures.

Chemistry must continue to play an important role also in the development of methods for the quantitative determination of amino acids in foods. These methods must be perfected if we are to put nutrition on an amino acid basis.

It must be recognized, however, that quantitative data on the food supply are not the whole story. Questions of availability and degree of utilization arise. Chemical or microbiological data on amino acid content must be checked by animal studies of the biological value of the protein concerned. Animal experiments show that heat improves this value for the protein in some foods, such as soybeans, and hurts the value in other foods, such as cereals. Yet, in neither case has amino acid content been altered appreciably according to recent studies. It is considered in the case of soybeans that heat destroys an interfering antienzyme. This explanation raises the general question as to what extent heat or other conditions to which food is subjected before it reaches the table affect the activity of either enzymes or antienzymes concerned.

Further studies need to be made on the extent to which the amino acid mixture found in the food corresponds to the resulting metabolic mixture presented to the tissues for utilization. A recent report by Melnick suggests that the actual biological value of a given protein intake may be markedly different from that suggested by its amino acid make-up, because these acids are liberated in digestion at varying rates and thus absorbed at different times. The mixture presented to the tissues differs accordingly.

In supplying body needs the nutritionist must deal with the nutritional quality of foods as they reach the consumer's table. It is recognized, however, that this quality depends upon many previous operations. From this standpoint, nutrition actually begins with the soil, because how food crops are produced markedly influences their nutrient content. The practical importance of the nature of the soil has long been evident in terms of the nutrition and health of grazing animals. The case of cobalt has been mentioned. A similar story could be told for phosphorus, copper, calcium, and other minerals. Whether it is practicable and important in human as well as animal nutrition to make good these deficiencies through fertilization constitutes a question of prime importance. We do not have today, however, any general formula for soil treatments which can be counted on to eliminate these deficiencies in food crops. The soil is a complex physical, chemical, and biological system, and basic studies rather than trial-and-error methods are required to obtain significant data.

We need to know how soil deficiencies affect not only the mineral content of food, but also its organic constituents. Here we are concerned with the amount and biological value of the protein present and also with the vitamin relations. Almost all of the vitamins needed in the human diet are products of plant metabolism. It is reasonable to believe that their formation is influenced by cultural conditions, and yet we are very ignorant of this phase of plant physiology. There is need for the same basic chemical studies of the metabolism of vitamin formation in our food supply as are being carried out in connection with vitamin utilization in the body.

The practical importance of the soil in relation to the nutritional quality of the human food largely remains to be demonstrated. In the meantime, however, enthusiasts are extolling soil treatments as the solution for human ills. It is unfortunate to have the public warned by a responsible writer that "the baby won't have good bones if its formula is made of milk from a cow whose feed came from a soil deficient in calcium and phosphorus" and that "the adult won't build muscle and good red blood from a steak devoid of protein-building minerals and iron." No alteration of the ration, much less of the soil, can influence in any significant way the amount of calcium, phosphorus, protein, or iron an animal puts in its milk or its muscles. It takes a lot of effort to counteract the effects of such statements, even when all the scientific facts are available. Even though the extreme claims obviously are untenable, much more research is needed in the general field, because it seems clear that when all the facts are known, generalizations of practical value can be established.

Some important relations between climate and nutritive value have already been established. For example, research has clearly shown, in the laboratory and in the field, that light intensity prior to harvest has an important influence on the vitamin C content of certain fruits and vegetables. It has been demonstrated experimentally that the concentration of this vitamin in turnip greens increases 8-fold in a week as the light intensity is increased from 200 to 5,000 foot-candles. We cannot expect to control climate, but we can take climate into account in deciding where certain crops should be grown. We may modify certain greenhouse practices where nutritive value is markedly concerned.

The variety of the specific crop grown is also important. Different varieties of a given fruit or vegetable may differ widely in certain nutritive values when grown side by side in the same soil during the same season. It seems clear that in breeding for yield and so-called market quality, nutritive values have been adversely affected, in some instances at least. More important, it has been shown that new varieties with higher nutritive values can be developed through appropriate breeding and selection. In fact, this may well prove to be the most effective way of improving the nutritional quality of our food supply as produced.

The progress already made in this general field of food crop production makes it clear that the problems are of sufficient importance and the results to date sufficiently promising to justify research programs of a magnitude and character essential to explore fully the possibilities involved. Integrated studies by soil, plant, and nutrition scientists are called for to provide data which can be translated into reliable and practicable field procedures. Quick results are not to be expected. It took many decades to develop the present knowledge as to how to control cultural factors in the interest of maximum yield and desirable market qualities. Nor can one predict how important and how practical the final results will prove to be. As in the case of all other research, the answers can come only when all the facts are known. In such a program the chemist must play a large role.

With respect to products of animal origin, the principal factor causing nutritive variations is the feed of the animal. The vitamin value of butter is the outstanding example here. The mean annual potency of the butter produced in this country is around 15,000 I.U./pound. While summer butter is much richer than this general average, most of the winter butter ranges around 9,000 units. It would be entirely possible to raise the value of this winter butter and, more important, of the fluid milk supply by 50 per cent through appropriate feeding practices. These practices should not increase the cost of milk production, because the foods which will step up vitamin A value are those which will make the ration better in terms of total production as well.

Similarly, the vitamin A and vitamin D contents of eggs are markedly affected by the nature of the ration. Here again, the rations which promote the highest production also improve the nutritional quality of the eggs.

The importance of processing and storage factors in the nutritive value of food as it reaches the consumer is too well appreciated to call for any detailed comments. This has been a very active field of research during the war years. That much remains to be done is obvious. I think that advancement in this general field is being somewhat handicapped because so much of the research is on a commodity basis. This is the natural basis for the manufacturer or distributor who has a specific commodity to sell. It is the basis on which most of the state- and federally-supported research is organized. It overlooks the fact that biochemical changes are not peculiar to a single commodity, and, thus, the basic physical and chemical reactions and interreactions which may have a common influence on nutritive value, palatability, and other important qualities in many products particularly need attention. Chemists are more likely to be interested in basic reactions than in pecans, prunes, or some other special commodity for which a laboratory may be organized. More recognition of the importance of basic research would attract better scientists and thus make food research more productive.

In terms of consumer acceptance, palatability ranks above nutritive value, in part at least because palatability is the more obvious quality. It rests primarily on subjective measures. Biochemical measures are certainly needed, and here lies a very complicated problem indeed. Such measures would be useful all the way from the farm to market. Recent trends, in the marketing of fresh foods particularly, have tended to work against both palatability and nutritive value because the avoidance of losses through spoilage and the maintenance of a fresh

firm appearance have become so important in market quality. Fruits and vegetables are now being bred with these factors in mind and are being picked green to ripen in shipment or in storage. Both nutritive value and palatability suffer accordingly. Perhaps the chemist can help develop products which will be of the desired market quality in all respects through a better understanding of the basic changes involved.

In all research dealing with the food supply, it is clear that the economic aspects cannot be neglected. Since malnutrition is most prevalent among low-income groups, cheaper as well as more nutritious foods are called for. This means all possible economies in production and distribution, particularly in the case of the more nutritious and preferred products. But attention to low-cost foods which are widely consumed, though not outstanding in any particular nutrient, is also important. Potatoes are such a food. If all the potatoes consumed in the United States in 1945 contained, as eaten, the vitamin C present when they were dug, over half the recommended allowance for our entire population would thus have been met. Unfortunately, most of it was lost before it got to the table. The actual amount of the losses is not known, but they can be as high as 50 per cent or more in storage, depending on how the potatoes are stored and for how long, and from 15 to 60 per cent or more of what is left can be lost in cooking. A substantial part of these losses could be prevented. Potatoes, as now marketed and consumed, do not get the credit they deserve in terms of vitamin C content, but more attention to conserving the nutritive values of this cheap, everyday food would do much to improve nutrition where the need is greatest, namely, among the low-income groups. It would greatly increase the value attached to potatoes as an article of the diet. Cooking losses must be accepted, but they can be reduced by taking advantage of facts now established. Storage losses merit much more study. In terms of national nutrition, foods which are rich sources of a given nutrient may be less important than a poor source which, because of its much larger consumption, makes a larger per capita contribution of the nutrient in question.

When the need for the improvement of the nutritive value of the food supply is mentioned to leaders in either agriculture or the food industry, a frequent response is: "It will cost money; will the consumer pay more accordingly?" The fact is that the consumer is, in many instances, not now getting the nutritive value he thinks he is paying for because of modern marketing developments. When he comes to realize this, the market for present products may be adversely affected. Further, it is a false assumption that improving nutritive value must mean a more costly product. As Dr. Wade, director of the Breeding Laboratory at Charleston, puts it in the case of improvement through breeding:

> If some agency interested in the public welfare absorbs the cost of research in the production of new varieties with improved nutrition values, then there is no reason for the public's paying increased prices. Our experience in breeding improved varieties would indicate that those with high nutritive value can be as productive as those with lower values.

Almost the entire biological cycle has been covered in this discussion of food problems beginning with the soil and ending with the excretory products resulting from food metabolism. The nutrition scientist has a real interest in all of the problems involved, in promoting and assisting in their study, and in seeing that nutrition goals are kept in mind. Some of them are so interrelated that they should be studied together rather than piecemeal. Coordinated attacks by men with varied training and interests are called for. A wider recognition as to how these diverse problems are related to the advancement of nutrition should make the individual worker more effective in his specific area, as well as serving to promote the integrated research called for in the over-all field. In such a program the chemist must continue to play a primary role.

Legislation Affecting Scientists in the Armed Forces

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TWO BILLS HAVE BEEN INTRODUCED into the 80th Congress which, if passed, would have widespread effects upon the status and effectiveness of scientific personnel in the Armed Services. These indicate the necessity for closer scrutiny of Service scientific programs by civilian scientific groups.

During World War II no lesson was driven home more forcibly than the importance of scientists in national defense. Large numbers of scientific personnel were utilized in research, selection, operations, and training. It may be assumed that the Armed Services will continue to conduct research in peacetime and to enlist the assistance of civilian groups.

Although there may be differences of opinion as to the amount or type of research which should be performed within the Armed Services, there is no question as to the importance of at least some scientific personnel in these Services. First, such personnel is required to perform whatever research the Services will do. Second, it is required in establishing policies at high levels, as exemplified by the Joint Research and Development Board. This group is especially important and calls for men with a great appreciation of the scientific point of view not only to insure adequate exploitation of scientific advances but also to establish and carry out necessary over-all research plans. This includes planning for and supporting research within the Armed Services themselves as well as in civilian institutions where Service-sponsored projects are undertaken. A third purpose is to review continuously research results from civilian laboratories to discern those which may be of importance in promoting national defense, at the same time serving as a bridge across the gap which usually exists in peacetime between military personnel and civilian scientists.

The organizational structure, magnificent facilities, and a potentially ideal environment for research are now in existence within the Armed Services. However, it must be recognized that the entire scientific program of these Services is potentially impotent without competent scientific personnel. The responsibility for the success of this program rests on the shoulders of both the Armed Services and the entire group of scientists in the United States. If a scientist possesses a skill which can be utilized in national defense, it is inevitable that he will be called upon as soon as even a potential emergency appears. Although he may not be placed in uniform, he will, nevertheless, have a very tangible connection with the military effort. The civilian scientist should insist that there be a sound research structure within the Armed Services not only because of his interests in national defense but also because of a more selfish interest—assurance of his maximal utilization in the capacity for which he is best suited in the event of an emergency. The importance of this cannot be overemphasized.

The mobilization of science in World War II began in 1940 with the establishment of the National Defense Research Committee. During the war a large number of scientists found themselves either in the Armed Services or working under OSRD contracts. With the cessation of hostilities, it was logical for this mobilization to be reduced. However, the number of scientists who left the Armed Services was entirely out of proportion to the decreased requirements—so many left as to seriously hamper military research efforts. The situation is summarized in the following statement taken from the history of the Armored Force Research Laboratory published shortly after V-J Day.

> The fact that not one of the members of the laboratory staff was interested in staying in the peacetime Army or continuing to do research under the Army is silent testimony which has a self-evident interpretation. Unless the Army is able to attract personnel of a high type, its program of research will die in infancy. This is true whether the program is set up within the Army or carried on by civilian scientists under the auspices of the Army (*i.e.* Civil Service).

This experience was not limited to one laboratory and nowhere is it more applicable than to the facilities and personnel of the Medical Departments of the Services.

Under the aegis of the Medical Department, biological scientists made great contributions to the solution of problems arising as a result of scientific advancements which increased tremendously the performance of weapons and machines without concomitant increases in human capabilities.

The success of the various activities staffed by scientific personnel, including the Service research laboratories, the Aviation Psychology, Aviation Physiology, and other programs, brought to the Medical Departments the realization of the necessity for continuing these functions. This realization has led to the

[1] Formerly Lt. Colonel, Medical Corps, U. S. Army, and Director of Research, Air University School of Aviation Medicine, Randolph Field, Texas.

introduction into Congress of the two above-mentioned bills which bear directly upon the problem of the status of the biological scientist in the Armed Forces. These bills, pertinent sections of which follow, have been referred to the Senate Committee on Armed Services.

S. 334

A bill to establish the Medical Associated Sciences Corps in the Medical Department of the Navy, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there is hereby established the Medical Associated Sciences Corps which shall be a constituent part of the Medical Department of the Navy and which shall consist of not more than two hundred and five officers of the grade of medical associated scientist. Officers of the grade of medical associated scientist shall have the rank of captain, commander, lieutenant commander, lieutenant, or lieutenant (junior grade), and such officers shall be part of the authorized strength of the various corps of the Medical Department as now exist or may hereafter be established.

SEC. 2. Medical associated scientists shall be staff officers and shall be subject to all provisions of law now existing or hereafter enacted relating to the advancement in rank and retirement of officers of the Medical Corps. No officer of the Medical Associated Sciences Corps shall be entitled to command in the line or any other staff corps of the Navy, nor shall any officer suffer reduction in pay or allowances by reason of appointment in accordance with this Act.

SEC. 3. All appointments to the grade of medical associated scientist shall be made by the President, by and with the advice and consent of the Senate, and shall be from male citizens of the United States who shall have received a doctorate degree in such sciences related to medicine that the Secretary of the Navy shall determine.

* * *

SEC. 5. All appointments to the grade of medical associated scientist, except those provided for in section 4 of this Act, shall be with the rank of lieutenant (junior grade) from male citizens of the United States between the ages of twenty-one and thirty-two years. No person shall be appointed pursuant hereto until he shall have established his mental, moral, physical, and professional qualifications to the satisfaction of the Secretary of the Navy.

* * *

S. 504

A bill to revise the Medical Department of the Army, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Army Medical Department Act of 1947."

TITLE I

Medical Service Corps

SEC. 101. Effective the date of enactment of this Act, there is established in the Medical Department of the Regular Army the Medical Service Corps, which shall consist of the Pharmacy Section, the Medical Allied Science Section, the Optometry Section, and such other sections as may be deemed necessary by the Secretary of War, and which shall perform such services as may be prescribed by the Secretary of War. The authorized strength of the Medical Service Corps, Regular Army, shall be such strength as may from time to time be prescribed by the Secretary of War. The Medical Service Corps, Regular Army, shall consist of officers in the grades of second lieutenant to colonel, inclusive: *Provided*, That the number of colonels on active duty in the Medical Service Corps, Regular Army, shall at no time exceed 2 per centum of the authorized Regular Army officer strength of such corps.

SEC. 102. (a) From the officers commissioned in the Medical Service Corps, Regular Army, in the permanent grade of major or above, the Secretary of War shall appoint the Chief of the Medical Service Corps who shall serve as such Chief during his pleasure, and who, if commissioned in permanent grade below colonel shall, without vacation of his permanent grade, have the temporary rank, pay, and allowances of a colonel while so serving, and who, while so serving, shall be superior in rank to all other colonels in the corps.

(b) From the officers commissioned in the Medical Service Corps, Regular Army, the Secretary of War shall appoint such assistant chiefs, who shall be chiefs of sections, and who shall be consultants to the Surgeon General in activities relative to that specific section.

* * *

SEC. 103. Except as provided in Public Law 281, Seventy-ninth Congress, approved December 28, 1945, as amended, and except as hereinafter provided for transfer thereto, original appointments in the Medical Service Corps, Regular Army, shall be made only in the grade of second lieutenant from citizens of the United States between the ages of twenty-one and thirty years, who possess such physical and other qualifications as may be prescribed by the Secretary of War.

SEC. 104. Effective from date of enactment of this Act, commissioned officers of the Medical Service Corps, Regular Army, shall be promoted to the grades of first lieutenant, captain, major, and lietuenant colonel as now or hereafter prescribed for promotion of promotion-list officers to such grades, respectively. Promotion to the grade of colonel shall be by selection under regulations prescribed by the Secretary of War from officers in the grade of lieutenant colonel with at least one year's service in that grade.

* * *

The bill then provides that Public Law 281, as amended, be further amended by inserting in lieu of paragraphs (c) and (d), Section 5, of the Act the following paragraph:

SEC. 105. "(c) Persons appointed in the Medical Service Corps shall be appointed in grades of second lieutenant, first lieutenant, captain, or major according to the periods of service with which they are credited in the same manner as set forth in paragraph (a) of this section for persons appointed in arms and services of the Regular Army, the officers of which are on the promotion list."

* * *

SEC. 106. Officers of the Regular Army who, on the date of enactment of this Act, hold commissions in the Pharmacy Corps, are, effective the date of enactment of this Act, transferred in grade to the Medical Service Corps. Each such officer so transferred shall be reappointed in the Medical Service Corps in the permanent grade held by him at the time of such transfer; shall be credited for the purpose of determining eligibility for promotion, with continuous commissioned service on the active list of the Regular Army in the Medical Service Corps equal to the period of service credited to him for promotion purposes under existing provisions of law, and shall, subsequent to such transfer, be thereafter promoted in accordance with the promotion system set forth in section 104 of this title.

SEC. 107. (a) Effective the date of enactment of this Act, the Pharmacy Corps and the Medical Administrative Corps are abolished. The functions of the Medical Service Corps created by this Act shall include the duties and functions heretofore prescribed for the Pharmacy Corps and the Medical Administrative Corps.

(b) Effective the date of enactment of this Act, persons holding temporary appointments or commissions in the Army of the United States permanently assigned or detailed to the Medical Administrative Corps, the Pharmacy Corps, or the Sanitary Corps shall be automatically transferred and permanently assigned or detailed, as the case may be, to the Medical Service Corps, established by this Act, in the same temporary grade and rank held by them at such time.

* * *

If competent scientists are to be induced to enter the Armed Services, it is essential that they be given rank and prestige commensurate with their training and abilities. If they are to be used effectively, it is essential that their activities be directed by men with similar backgrounds and points of view. In these respects the Navy Bill, S. 334, is at least a step in the right direction. On the other hand, it is difficult to imagine how the Army Bill, S. 504, could possibly have been worse. It provides for initial commissions one grade lower than for physicians in the Medical Corps. The name of the corps emphasizes its subordinate position in the Medical Department. No educational or other qualification is prescribed. The scientists are grouped with optometrists, pharmacists, administrators, and others of the most diverse backgrounds and points of view. The chief of the corps, responsible for the establishment of policies governing personnel, research, liaison, etc., might belong to any one of these groups.

One defect in both bills is the failure to provide a means for at least initially commissioning senior scientific personnel at a rank commensurate with their abilities. It is this type of individual which is now most sorely needed. As written, the bills provide high-rank commissions only for those with previous military service. The Army Bill provides for rank no higher than that of major.

Another serious omission in both bills is the lack of provision for a reserve component. This is of especial importance to the civilian scientist, but it is also of great importance to plans of the Armed Services for the utilization of scientists in time of war. The Services have neglected to realize that a commissioned reserve scientific component will assist in stimulating and maintaining the interests of at least a small group of civilian scientists in Service problems.

Consideration should be given to including in both bills provisions for an integrated enlisted component in order to provide the necessary technicians and to avoid the constant loss and replacement of highly trained enlisted personnel which affected scientific programs so seriously during the war.

Lest individuals in the physical sciences feel that this is a problem solely for biological scientists, it should be pointed out that it is conceivable that similar legislation may be introduced to establish similar groups in other branches of the Armed Services. In addition, it is entirely possible that the attitude reflected in the Army Bill may be extended to the physical sciences. It is important, therefore, that *all* branches of science attempt to correct this situation in its incipiency.

These bills, together with the imminence of unification of the Armed Forces and the partial recognition of the importance of the scientist as evidenced by the prominence of the Research and Development Board, bring forward the question of the establishment of an over-all Science Corps in the Armed Services. Conceivably, such a corps could consist of Physical Science and Biological Science Divisions, have cognizance of all research and scientific effort in the Armed Forces, and have representation at the highest and all other staff levels. If such a corps is believed to be desirable, efforts should be made by scientists as a whole to establish it in the near future.

The only means of correcting the present legislation is for scientists, especially those who are veterans of World War II, to protest directly to the Committee on Armed Services, U. S. Senate, against the objectionable provisions contained in S. 504.

NEWS *and Notes*

The Senate Committee on Labor and Public Welfare has reported favorably on National Science Foundation Bill S. 526, with amendments, as effecting a compromise between S. 525 and the original S. 526 (*Science*, February 21 and March 7). Major amendments to this bill provide that: (1) the Foundation shall consist of 24 members, the President being requested to give due consideration to recommendations from the National Academy of Sciences, Association of Land Grant Colleges and Universities, National Association of State Universities, or other scientific or educational organizations; (2) terms of office shall be staggered so that, following initial establishment of the Foundation, one-quarter of the members are appointed every two years; (3) the Committee for the Division of National Defense shall consist of not less than 12 or more than 36 members, half to be civilians appointed by the Foundation and half, representatives of the armed services, designated in equal numbers by the Secretaries of the principal branches of these services; (4) there shall be an executive committee of not more than 6 members within the Division of National Defense; (5) the Committee for this Division shall advise the Director on security classification matters; (6) no officer or employee of the Foundation shall acquire, retain, or transfer any rights, under patent laws of the U.S. or otherwise, in any invention produced in connection with his assigned activities and directly related to the subject matter thereof; (7) in making contractual or other arrangements for research, attention be given also to aiding institutions, agencies, or organizations which show potentiality for advancing research, as well as encouraging independent research by individuals; (8) funds available to government agencies for scientific or technical research or development may be transferred to the Foundation upon approval of the head of any such agency; and (9) the National Roster shall be transferred to the Foundation.

Discussion of amended S. 526 on the Senate floor is imminent. At the time of debate, Senator Wayne Morse will recommend a further amendment to the effect that a minimum of 25 per cent of all funds (exclusive of those for national defense) shall be distributed on a geographic and population basis among the states, such amounts to be expended only for research activities in tax-supported colleges and universities, including land-grant colleges, and an additional amount of not less than 25 per cent shall be expended in nonprofit organizations.

Five committees have been organized to direct local arrangements for the 114th meeting of the AAAS to be held in Chicago December 26–31, 1947: Finance, Equipment, Reception and Entertainment, Registration, and Publicity. At preliminary meetings held April 7–9, these committees elected officers, prescribed their respective functions, and discussed matters of general policy relating to the organization of the annual meeting.

The Equipment Committee elected R. T. Van Niman, Chicago Technical Societies Council, as its chairman. Members are: G. M. Bench, Chicago Board of Education; Donald Boardman, Wheaton College; J. M. Bradford, George Williams College; Leonard Freese, National College of Education; John Hudson, Loyola University; Weston L. Krogman, University of Chicago; C. Kutrumanos, Elmhurst College; Theodore F. Lindgren, Illinois Institute of Technology; M. C. Lobstein, Chicago Museum of Science and Industry; John R. Millar, Chicago Natural History Museum; John B. Murphy, DePaul University; Charles S. Seevers, Roosevelt College; B. J. Spence, Northwestern University; Eliot C. Williams, Chicago Academy of Sciences; and W. R. Williams, University of Illinois. The Committee's functions include a survey of session rooms, procurement and distribution of projection machines, blackboards, public address systems, signs, and other items of equipment, and the scheduling of projector operators. Because of high rental costs and the exorbitant union wage rate of $11 a session for operators, it was the consensus of this Committee that requests for projection equipment be restricted to cases in which its use is absolutely necessary for clarity of presentation, and that papers supplemented by projections be combined in one or two sessions.

The Reception and Entertainment Committee elected Miss Margaret Scriven, Chicago Historical Society, as its chairman. In arranging the General Reception for members of the AAAS, a women's tea, tours of educational and industrial organizations, and other special functions, Miss Scriven will be assisted by: Bernard J. Babler, DePaul University; Benjamin Burack, Roosevelt College; J. C. Chaderton, University of Illinois; Harold Davis, Northwestern University; Alfred E. Emerson, University of Chicago; Alvin Johnson, Elmhurst College; Robert C. Kintner, Illinois Institute of Technology; Anna P. Kummer, Chicago Academy of Sciences; A. C. Maack, Chicago Technical Societies Council; D. M. MacMaster, Museum of Science and Industry; K. Lucille McCluskey, Saint Xavier College for Women; Karl P. Schmidt, Chicago Natural History Museum; A. H. Steinhaus, George Williams College; and Paul Wright, Wheaton College.

The Registration Committee elected Hans O. Hoeppner, University of Chicago, as its chairman. Dr. Hoeppner at one time supervised the annual convention of the Kiwanis Clubs and is well qualified to direct his Committee in making the physical arrangements for registration. Those serving with him are: Sister Mary Bertha, Saint Xavier College for Women; Angeline Brandt, Wheaton College; Edward M. A. Chandler, Roosevelt College; Earl A. Davis, Jr., Elmhurst College; Clarence E. Deakins, Illinois Institute of Technology; Ralph O. Freeland, Northwestern University; Theodor K. Just, Chicago Natural History Museum; G. L. Schuytema, George Williams College; John M. Spence, University of Illinois; Kathryn J. Stephenson, Chicago Academy of Sciences; James J. Vasa, DePaul University; and Elmer

Wirth, Chicago Technical Societies Council.

The Publicity Committee will staff and equip a press room in the headquarters hotel for press representatives. It will also carry on a local campaign by press and radio to stimulate interest and cooperation among Chicago residents in the AAAS meetings and those of its many affiliated societies. Miss Jeannette Lowrey, University of Chicago, was elected chairman. Members include: Sister Mary del Rey, Saint Xavier College for Women; H. DeBruine, Elmhurst College; J. W. Fuhrer, George Williams College; L. M. Glassner, Chicago Technical Societies Council; J. L. Leedy, Wheaton College; Paul S. Martin, Chicago Natural History Museum; William V. Morgenstern, University of Chicago; Carl C. Pfeiffer, University of Illinois; Arthur J. Schaefer, DePaul University; Edward Stromberg, Northwestern University; Frank E. Wheeler, Illinois Institute of Technology; and Eliot C. Williams, Jr., Chicago Academy of Sciences.

The Finance Committee, under the chairmanship of W. P. Cortelyou, Roosevelt College, will subscribe the funds necessary to meet the expenses incurred by the local committees. Preliminary budget estimates indicate that these expenses will be close to $4,000, exclusive of the contributions of time by more than 70 committee members. Dr. Cortelyou will be assisted by: Sister Stella Maria, Saint Xavier College for Women; Marion Barnes, Wheaton College; John K. Baumgart, Elmhurst College; Anton J. Carlson, University of Chicago; Nathan S. Davis, Chicago Academy of Sciences; F. R. Eckford, George Williams College; Gilbert A. Force, Illinois Institute of Technology; Garfield King, Chicago Historical Society; C. I. Reed, Chicago Technical Societies Council; Colin C. Sanborn, Chicago Natural History Museum; David M. Sharer, DePaul University; Robert K. Summerbell, Northwestern University; and G. E. Wakerling, University of Illinois.

An executive session was held by committee chairmen to discuss the coordination of committee plans and the nomination of a General Chairman. This session was also attended by G. M. Schmeing, Loyola University, and D. M. MacMaster, Museum of Science and Industry. In order that the visiting scientists shall participate in bearing the heavy financial cost of the meeting, it was recommended by this Executive Committee that registration be made mandatory by restricting attendance at the sessions to those who register.

A Nominating Committee was also established to name candidates for general chairman of the Meeting. In the near future the Executive Committee will reconvene at the call of Dr. Hoeppner, who is serving as chairman pro tem, to elect the chairman.

The spontaneous and enthusiastic nature of the discussions at these first meetings of the local committees reflect a spirit of cooperation that will make the 6th Chicago Meeting one of the most memorable in the history of the Association.

About People

Robert P. Sharp, University of Minnesota, has been appointed professor of geomorphology, Division of Geological Sciences, California Institute of Technology, to begin September 1.

Betty Kellett Nadeau has been named research associate and lecturer in geology, Department of Geology and Geological Engineering, Washington University, St. Louis, to conduct research in micropaleontology.

David Krech, assistant professor of psychology, Swarthmore College, has been appointed associate professor of psychology at the University of California, Berkeley, beginning with the academic year 1947–48.

R. G. Sachs, Argonne National Laboratory, has been appointed associate professor of physics at the University of Wisconsin. The appointment becomes effective this coming fall.

Colleges and Universities

Harvard University has announced that its president, James B. Conant, will teach a course in "The Growth of the Experimental Sciences" in the University's new program of General Education next fall. Intended to give nonscientists a background in science, the course will draw on Dr. Conant's book, *On understanding science*, published this spring. This is the second time in Harvard history that a president has taught a course in the modern sense of the word, President Lowell having taught Government I in 1917–18.

At the same time Harvard announced plans for expansion of its new program of General Education to include additional students in all classes and extend the courses on a more mature basis to juniors and seniors. The action follows six months of successful experience with small classes in General Education for freshmen and sophomores.

Through General Education courses in the humanities, physical sciences, and social sciences, aimed to give students a "clear appreciation of the range of human experience and achievement," the University states it is working toward a fundamental change in the elective system of undergraduate instruction. Ultimately it is planned to make the courses required for all undergraduates.

The conviction of President Conant and other officials at Harvard that the elective method did not meet students' needs for a well-rounded program of study resulted in a two-year study by a faculty committee which published a report, "General Education in a Free Society," in 1945. The findings were put into practice on an experimental basis last fall.

Elections

The Los Angeles Society of Internal Medicine, formerly Internal Medicine Section, Los Angeles County Medical Association, has elected Gurth Carpenter, president, Harold J. Hoxie, vice-president, and Edgar F. Mauer, secretary-treasurer, for 1947.

The Royal Astronomical Society has elected the following officers: president—W. M. H. Greaves, Astronomer Royal for Scotland and professor of astronomy, University of Edinburgh; vice-presidents—M. G. Adam, chief assistant, University Observatory, Oxford; M. Davidson; H. H. Plaskett, Savilian professor of astronomy, University of Oxford; and D. H. Sadler, superintendent of the Nautical Almanac; treasurer—Sir Harold Spencer Jones, Astronomer Royal; secretaries—W. H. McCrea, professor of mathematics, University of London; and A. D. Thackeray, assistant director, Solar Physics Observatory, Cambridge; and foreign secretary—F. J. M. Stratton, professor of astrophysics and director of the observatories, University of Cambridge.

TECHNICAL PAPERS

Action of Substituted Salicylaldehydes on Bacteria and Fungi

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While testing the halogenated and/or alkylated saligenins as gram-negative antiseptics, it was thought desirable to test the corresponding salicylaldehydes. Previous to the work which is described in part in this report, these aldehydes had been only superficially investigated for antiseptic activity (*1*). However, as a result of extensive testing carried out on these compounds, particularly on the dibrom derivative, the salicylaldehydes have been shown to possess marked fungicidal and bactericidal activity.

The main problem to be solved before testing the salicylaldehydes was to find a satisfactory means of dissolving these normally insoluble compounds at a suitable pH (*1*) and in a solution which contributed no antibacterial activity. To this end, two methods were developed.

The first involved mixing the free aldehyde with an excess of borax and making an aqueous solution from this mixture. Thus, a stable preparation is obtained at a satisfactory pH and without the irritating properties associated with solutions of the salicylaldehydes alone. The second method made use of the aldehyde-bisulfite compound in conjunction with an equimolecular amount of sodium hydroxide. The solutions thus obtained are apparently fairly stable and nonirritating. However, on long standing, there is complete decomposition to the parent aldehydes. From a bacteriological standpoint there is no apparent difference on a mole-for-mole basis between the two types of preparation.

Antiseptic testing was carried out by serial tube dilutions, using as test organisms the bacteria listed in Table 1. The results indicate that several of the compounds are promising as antiseptics against both gram-positive and gram-negative bacteria. As gram-negative infections do not generally respond well to the usual gram-positive antiseptics, the latter activity is very significant. This will be reported in detail elsewhere.

The salicylaldehydes prepared were also tested for fungistatic activity against *Trichophyton mentagraphytes* #640, a common pathogenic fungus. The method used was that described previously (*2*). From the results shown in Table 2 it will be noted that several of the compounds exhibit marked fungistatic activity against the fungus strain used. In addition, further studies based on tests described by Schamberg and Kolmer (*4*) show that the salicylaldehydes are fungicidal as well as fungistatic against *T. mentagraphytes*.

TABLE 2

FUNGISTATIC ACTIVITY OF SUBSTITUTED SALICYLALDEHYDES AGAINST *Trichophyton mentagraphytes* #640

Name	Fungistatic effect in mm. of inhibition Concentration of compound				
	5%	0.5%	0.05%	0.005%	0.0005%
Salicylaldehyde	Comp.*	0	0	0	0
5-Chlorsalicylaldehyde	"	Comp.	2	0	0
5-Bromsalicylaldehyde	"	"	1	0	0
5-Iodosalicylaldehyde	"	"	3	0	0
5-tert-Butylsalicyaldehyde	"	"	0	0	0
3,5-Dichlorsalicylaldehyde	"	"	15	2	0
3,5-Dibromsalicylaldehyde	"	21	11	8	0
3-Chlor-5-bromsalicylaldehyde	"	25	14	2	0
3-Chlor-5-tert-butylsalicylaldehyde	"	Comp.	14	0	0
3-Brom-5-tert-butylsalicylaldehyde	"	35	12	0	0

* Indicates complete inhibition on a 90-mm. cup-plate.

TABLE 1

ANTIBACTERIAL EFFECT OF SUBSTITUTED SALICYLALDEHYDES ON CERTAIN BACTERIA

Compound	*Staphylococcus* 209		*Shigella shiga*		*Pseudomonas aeruginosa*		*Streptococcus* C-203
	Dilutions of compounds inhibiting 24-hour cultures						
	With serum	Without serum	With serum	Without serum	With serum	Without serum	With serum
Salicylaldehyde	1: 500	1: 2,000	1:2,000	1:2,000	1: 500	1:1,000	1:1,000
5-Chlorsalicylaldehyde	1:4,000	1: 8,000	1:4,000	1:4,000	<1: 500	<1: 500	1:4,000
5-Bromsalicylaldehyde	1:2,000	1: 8,000	1:4,000	1:8,000	<1: 500	1: 500	1:2,000
5-Iodosalicylaldehyde	1:4,000	1: 4,000	1:2,000	1:2,000	<1:2,000	<1:2,000	1:4,000
5-tert-Butylsalicylaldehyde	1:2,000	1:16,000	1:1,000	1:2,000	<1: 500	<1: 500	1:4,000
3,5-Dichlorsalicylaldehyde	1:4,000	1:64,000	1:8,000	1:8,000	1: 500	1: 500	1:8,000
3,5-Dibromsalicylaldehyde*	1:4,000	1:64,000	1:4,000	1:4,000	1: 500	1: 500	1:4,000
3-Chlor-5-bromsalicylaldehyde	1:4,000	1:32,000	1:2,000	1:8,000	1: 500	1: 500	1:4,000
3-Brom-5-tert-butylsalicylaldehyde	1:4,000	1:64,000	1:1,000	1:2,000	<1: 500	<1: 500	1:8,000

* "Dalyde," H. W. & D. brand of dibromsalicylaldehyde.

Thus, on the basis of the preliminary experiments reported here, it can be seen that the series of compounds in question shows activity against both fungi and gram-negative and

gram-positive bacteria. The preparation of dibromsalicylaldehyde solubilized with borax was singled out for extensive *in vitro* and *in vivo* testing against both bacterial and fungal infections. The reports of these studies will be the subject of subsequent publications by our collaborators (*3*).

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Prediction of Speed of Performance by Muscle Action Potentials[1]

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By the use of a new electronic counting technique a rather remarkable relationship has been found between reaction time to aperiodic stimuli in a monotonous situation and frequency of muscle action potentials (recorded from bipolar electrodes the same supraorbital electrodes, and muscle action potential rate from electrodes on the hand while responding were also simultaneously recorded on a Grass ink-writing oscillograph.

The electrodes were small solder discs attached to the surface of the skin with adhesive tape. Washing the skin with ether and applying a small amount of electrode jelly between skin and electrode served to make a satisfactory low-resistance contact (R = approximately 20,000 ohms). A ground electrode was attached to the subject's cheek.

Fig. 2 shows graphically the gradual transition from sleep to a condition of normal alertness as measured by the reaction time, associated muscle spike frequency, and low-frequency potentials from the supraorbital placement. At the point in the record indicated by the arrow, the experimenter knocked vigorously on the door of the shielded room. The stimulus before the knock had elicited no response, line #2 had shown no muscle activity for the previous 40 seconds, and line #3 showed alpha spindles at low amplitude only for the previous 5 minutes. The knock produced a "startle" reaction, with the immediate resumption of muscle spike activity, low-frequency activity, and a pressing of the response key in the absence of a stimulus. The second stimulus produced a response slower than normal, while the third stimulus, 6 seconds later, pro-

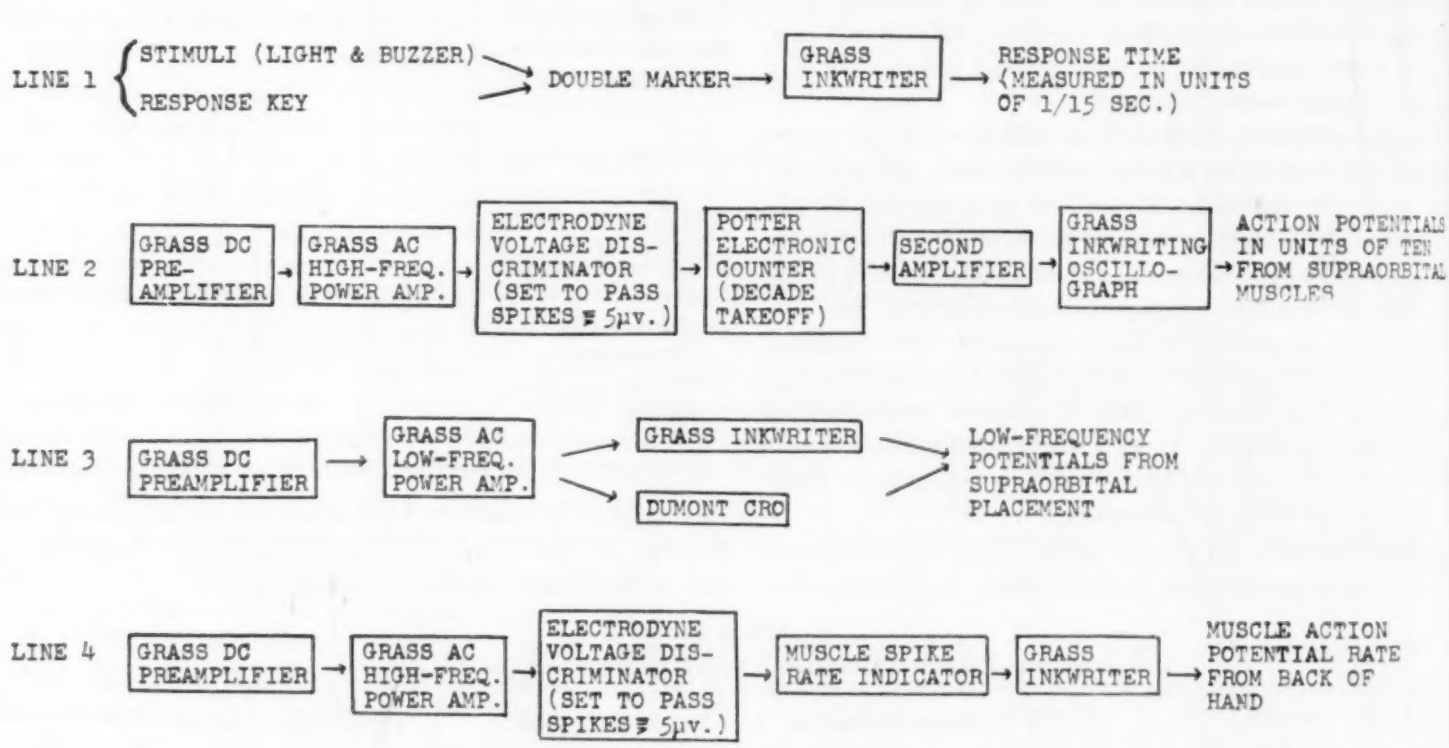

Fig. 1

placed above the eyes) during a 6-second interval before the onset of the stimuli.

The task was to respond by pressing a key as quickly as possible when occasional stimuli (simultaneous flash of light and sound of a buzzer) were presented. The subject was comfortably seated in an electrically shielded, sound-reduced darkroom. The schematic diagram (Fig. 1) shows the general relationships between the various electronic amplifying and recording units used in this study.

Presentation of the stimulus, occurrence of the response, frequency of action potentials from surface electrodes placed over the supraorbital muscles, low-frequency potentials from

duced a normal reaction time. Both responses are shown on line #4 as active contractions of the finger muscles.

It is feasible with this arrangement to achieve considerable versatility in studying a variety of muscle contraction problems under a variety of conditions of effort and work. Some specific data on one of these problems—the course of events in certain muscles only remotely involved in a long-continued task as the individual approaches a state of boredom and sleepiness—are presented here.

Fig. 3 shows the relationship between frequency of action potentials from electrodes placed over the supraorbital muscles and response time to a combined light and buzzer stimulus. The solid line represents the mean values; the vertical lines, the standard deviation above and below the mean. These data

[1] This work is supported by Contract N5ori-58 with the Human Engineering Section, Special Devices Center, Office of Naval Research.

were obtained from reading lines #1 and #2, portions of which are shown in Fig. 2.

Two major observations may be made from these data. First, there was a definite and distinct reduction in the number of muscle action potentials as the response time became longer. This was due, we presume, to an increasing boredom, sleepiness, etc. on the part of the subject. Secondly, the absolute variability markedly decreased with decreasing motor efficiency. The slight variation in the level of muscle activity for the last four response-time values and the NR (no-response) category is not as important as it may appear, in view of the fact that the average muscle spike count is about three per second and indicates an almost completely relaxed status of

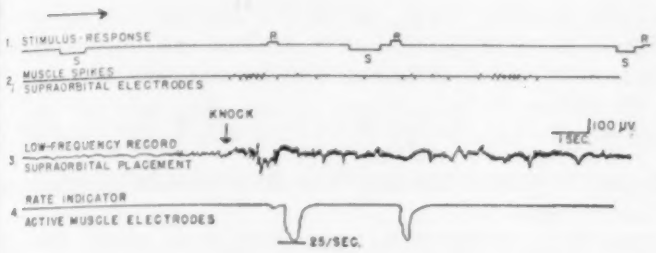

FIG. 2. Tracing of record showing transition from sleep to normal alertness.

the muscles involved. In the case of the NR category, the subject was asleep, and in most cases the stimulus served to awaken the subject on the first presentation, the response time rapidly approaching normal in subsequent presentations.

Recording line #3 (low-frequency record) in Fig. 2, although originating from the same supraorbital electrodes as line #2

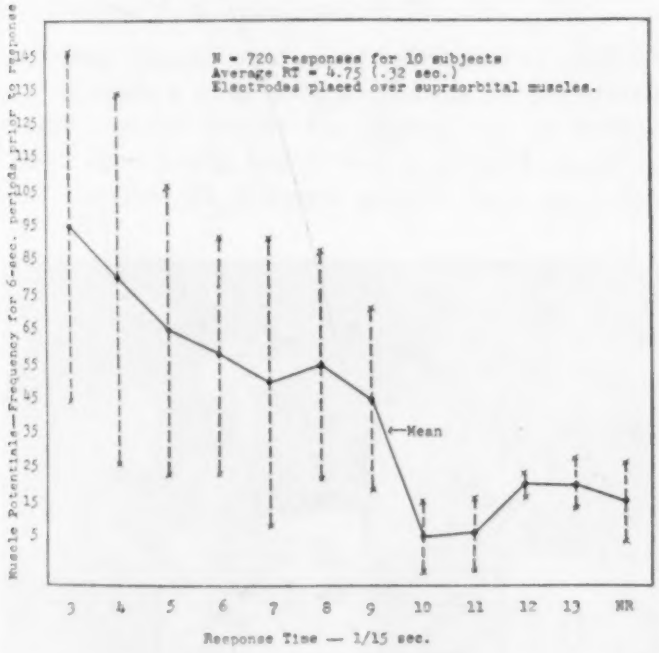

FIG. 3. Relation between response time and muscle spike activity from supraorbital electrode placement.

(muscle spikes), exhibited indications of brain activity (alpha waves). There is no doubt that muscle activity in this region of the forehead had a marked effect on the low-frequency record. On the other hand, the usual brain-wave phenomena were also exhibited along with the muscle activity. Sometimes line #2 showed great activity, with little or no activity on line #3, and line #3 showed considerable activity when line #2 was relatively inactive. It was evident that the low-frequency record gave valuable supplementary information, although the information is difficult to quantify. Furthermore, in all instances in which the subject had fallen asleep during a long, monotonous experimental session, both the high- and low-frequency records indicated a very "low-level" activity.

Line #4 in Fig. 2 indicates the effort put into the response by the subject in terms of muscle spikes per second of time from surface electrodes placed on the back of the hand over muscles involved in pressing the key. As the record shows, more effort was expended in the "startle" response to the knock on the door of the room than to the second stimulus.

It is believed that these techniques may make it possible automatically to warn personnel engaged in monotonous tasks, such as truck driving, before dangerous conditions of inalertness and approaching sleep occur.

Recovery of Western Equine Encephalomyelitis Virus From Wild Bird Mites (*Liponyssus sylviarum*) in Kern County, California[1]

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From the recently deserted nest of a yellow-headed blackbird, *Xanthocephalus xanthocephalus* (Bonaparte), in Kern County, California, approximately 1,000 mites were collected on June 21, 1946. These mites, which have been identified as *Liponyssus sylviarum* (Canestrini and Fanzago), were tested in four pools for the presence of a neurotropic virus. Each pool, containing approximately 250 mites, was ground in 3.0 cc. of 30 per cent rabbit serum-broth, centrifuged for 10 minutes at 3,000 r.p.m., and the supernatant fluid inoculated into 21-day-old mice by the combined intracerebral and intraperitoneal routes. None of the supernatant fluids contained enough bacteria to affect the animals. However, all the mice became ill or died between the third and sixth days after inoculation. Those observed while ill developed convulsions or other signs of encephalitis. Their brains were bacteriologically sterile. After three serial passages in mice were made of the agent isolated from each pool of mites, identification was undertaken. The

[1] This investigation was carried out in collaboration with the Commission on Virus and Rickettsial Diseases, Army Epidemiological Board, Preventive Medicine Division, Office of the Surgeon General, U. S. Army, aided by a grant from the National Foundation for Infantile Paralysis, Inc., and under contract with the California State Department of Public Health.

The authors are indebted to E. W. Baker, Division of Insect Identification, U. S. National Museum, for confirmation of the mite identifications; Frank Ehrenford and Ronald Reuther, who assisted in the collection of field samples; and Dorothy McAfee and Constance Morshead, who assisted in laboratory tests. Generous assistance and space for a field laboratory were supplied by the Kern County Health Department and General Hospital.

[2] Assigned to the George Williams Hooper Foundation through the California State Department of Public Health by the Communicable Disease Center, U. S. Public Health Service.

four infective agents proved to be pathogenic for guinea pigs and hamsters as well as for mice. Three of the four viruses isolated were shown to be Western equine encephalomyelitis, by challenge inoculation of Western equine immune guinea pigs and by neutralization tests in mice with specific Western equine antisera. The fourth virus shows certain antigenic peculiarities; this requires further study, the results of which will be reported at a later date.

From the nest of an English sparrow, *Passer domesticus* (Linn.), which contained two dead nestlings, a collection of 400 mites was made on June 28, 1946. This included two species which have been identified as *L. sylviarum* and *Dermanyssus americanus* Ewing. The collection was divided into two pools of approximately 200 mites each for inoculation into experimental animals. The same techniques as outlined above were used. From one of these pools Western equine encephalomyelitis virus was isolated.

Now, in addition to *D. gallinae* (*7*), at least one other genus of mites (*Liponyssus*) has been found which is naturally infected with the Western equine virus. The fact that three and possibly four isolations were made from one bird's nest incriminates as the source of infection at least one of the birds then or previously occupying the nest. Thus, evidence has been obtained regarding infection of *wild birds*, a *Liponyssus* mite, and possibly a *Dermanyssus* mite of wild birds with the Western equine virus. This evidence is similar to that reported by Sulkin (*7*) with Western equine virus and Smith, *et al.* (*6*) with St. Louis virus in the case of chickens and chicken mites. However, until persistence of infection and transmission by bite under experimental conditions is demonstrated, we prefer to reserve further interpretation of the possible role played by mites. *Culex pipiens* Linn. and *Anopheles freeborni* Aitken have been found naturally infected with Western equine virus (*4*), but their role as vectors has been discredited since experimental transmission could not be demonstrated (*2*). St. Louis virus will persist for some time in several species of anopheline mosquitoes, but transmission has not been effected (*1*, *8*). In this laboratory, over a period of six years, thousands of *D. gallinae* have been tested from encephalitis areas outside of California, all with negative results (*3*, *5*). In Kern County, an endemic area where surveys have been made for the past four years, *D. gallinea* have not been found in any chicken houses.[3] This suggests that it is not an essential vector or reservoir in one of the outstanding endemic areas.

These matters are emphasized not to indicate that mites are not suspected as vectors, but with the hope of preventing uncritical quotation or interpretation of mite findings.

Addendum: In 1877 Canestrini and Fanzago (*Atti Reale Inst. Veneto Sci. Let. Art.*, Ser. 5, **4**, 124–125) described *L. sylviarum* as *Dermanyssus sylviarum* n. sp. In 1884 Canestrini (*Ibid.*, Ser. 6, **2**, 1659–1660) placed the species in the new genus *Leiognathus* and used the specific name *silviarum*. The latter spelling has been commonly used by workers in acarology, whereas, according to the *International Rules of Zoological Nomenclature*, the original spelling, *sylviarum*, is correct.

L. sylviarum is known as the feather mite, or Northern fowl mite. It is commonly found on a wide range of wild bird species and is a serious pest of chickens in the northern part of the United States. In appearance this mite closely resembles *D. gallinae* (common chicken mite) but differs biologically in that it has a pronounced tendency to remain on its hosts at all times, taking blood meals repeatedly, and even laying its eggs among the feathers where they may hatch. *D. gallinae* usually leaves its host after feeding and deposits its eggs in cracks and crevices. The larval stage of *L. sylviarum* does not take a blood meal, as do the nymphal and adult stages.

Several authors have reported these two species of mites as attacking man and producing a pronounced dermatitis. This has not been our experience, although it has been a common occurrence to have hundreds of specimens crawling on laboratory personnel working with heavily infested bird nests. No bites have been noted.

[3] Unpublished data.

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Effect of 2,4-D on Bean Progeny Seedlings

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Seedlings of red kidney beans from parents sprayed with 2,4-D during the ripening of pods show a range of 2,4-D symptoms in the juvenile and mature foliage. Virus-like crisp foliage, dwarfing of growth, and serration and fusion of leaflets were noted in some degree in all seedlings. Parent

Fig. 1. Seedlings of normal habit from unsprayed parent (0) and those of dwarf habit, abnormal juvenile leaf texture, and fused mature leaf top (1) and of abnormal virus-like symptoms (1, bottom). These seedlings were from parent plant sprayed with 0.5 per cent 2,4-D.

plants were sprayed with 0.5 per cent and higher concentrations of 2,4-D amine salt. All seedlings showed characteristic 2,4-D injury. Unsprayed parents yielded normal seedlings

IN THE LABORATORY

Multiple Thermal Analyses

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One of the most useful techniques in the study of clay minerals is differential thermal analysis, a procedure which can be used for both qualitative and semiquantitative analysis of many minerals. In this technique a two-headed thermocouple is employed. One head is inserted in an inert material which does not undergo either exothermic or endothermic reactions through the temperature interval to be studied; the other is placed in the mineral or mixture of minerals under test. With constant heating rate, any thermal reaction in the sample will be recorded as a "peak" or a "valley" in the otherwise straight-line curve, dependent on the nature of the heat change.

Thermal curves have recently been obtained from 6 samples simultaneously on one record sheet. On another sheet, driven by

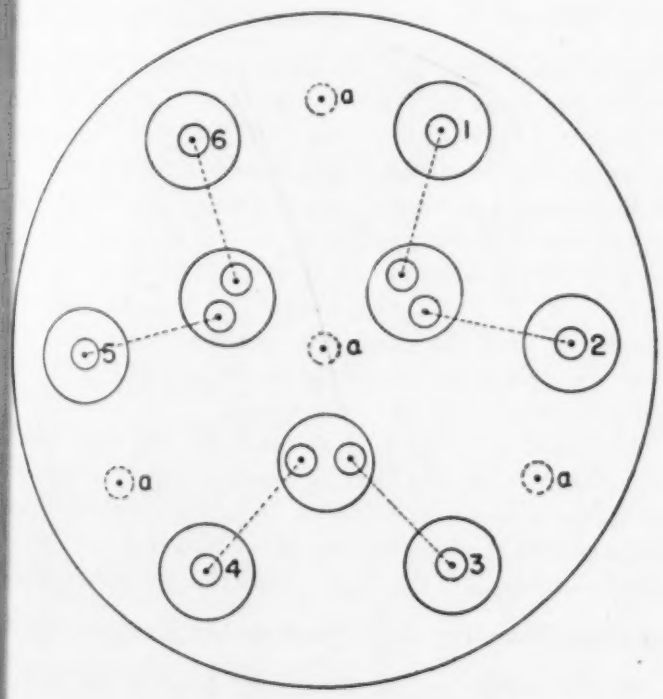

FIG. 1. Arrangement of samples in nickel block.

an electric motor synchronized with the multiple record motor, the temperature curve is drawn. The samples are mounted in a cylindrical resistance furnace. The pattern of the sample distribution in the vertical nickel block is shown in Fig. 1. The 6 samples to be tested are loaded in the outer holes, while the three inner holes are used for the inert material, purified alundum. The dotted lines indicate the connections between the two heads of the differential thermocouple. Dots "a" indicate the positions of the temperature-recording thermocouples. The heads of these couples are adjusted to the same height as the differential couples in the samples. The sample and alundum holes are $\frac{1}{4}$ inch in diameter and $\frac{3}{8}$ inch deep; the nickel block, $1\frac{3}{4}$ inch in diameter and $1\frac{1}{4}$ inch thick. A round cover of solid nickel, $\frac{1}{4}$ inch thick, is placed on top of this specimen holder to shield the samples from direct radiation.

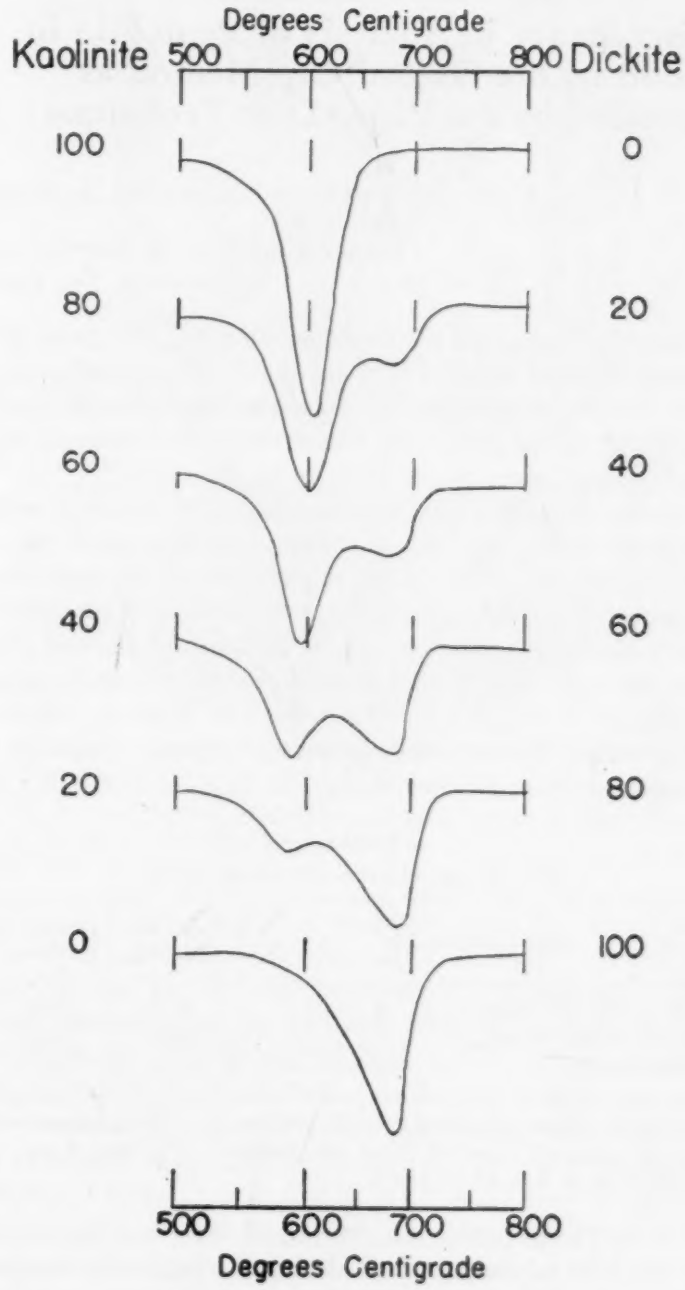

FIG. 2. Kaolinite-dickite mixtures.

The temperature thermocouple actuates a "micromax" recorder which is part of a program controller. A "speedomax," six-point, high-speed, electronic recorder with a maximum range of 3 mv is used to print the differential thermal curves.

Fig. 2 shows in a greatly reduced form a set of curves from one

[1] The writers are indebted to Dr. Sterling B. Hendricks, of the Bureau of Plant Industry, U. S. Department of Agriculture, for suggestions concerning the construction of equipment.

run for artificial mixtures of the clay minerals, kaolinite and dickite. Only the portions of the curves between 500° and 800° C. are shown in this diagram. The vertical coordinate for each curve indicates the relative intensity of endothermic reaction. The amplitude of the peaks is related to the percentage of the mineral present.

Two significant improvements in the technique of thermal analysis are evident with this type of apparatus. First, there is saving in time by running 6 instead of a single specimen. In an 8-hour day, 18 samples can be run conveniently. Second, there are certain inherent advantages in the simultaneous recording of 6 samples.

Discrepancy in Analysis of Penicillin in Blood by the Oxford Cup Method as Revealed by the Paper Disc Technique

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It is well known that low results are obtained when penicillin is assayed in the presence of blood by the Oxford cup procedure. We have found that this is not the case when the filter-paper disc technique is used. Under the same conditions, the latter method gives results close to the theoretical.

In the experiment to be described, three solutions were prepared by adding 0.5 ml. of concentrated penicillin in phosphate buffer to 4.5 ml. of the following blood fractions: defibrinated whole blood, oxalated blood, and serum. In subsequent dilutions for assay purposes, the ratio of the blood protein was maintained at a constant level of 90 per cent by using as diluent 90 per cent blood fraction and 10 per cent phosphate buffer. The resulting solutions were assayed against a standard solution of penicillin in 0.11 M phosphate buffer of pH 7.34. The technique described by de Beer and Sherwood (*2*) was used for the paper disc assays. The Oxford cup assays, performed simultaneously on the same solutions, employed glass cylinders (5.7–5.9 mm. inside diameter and 9.9–10.4 mm. high) as reservoirs. All other details, such as the agar medium, the *Bacillus subtilis* seed, the incubation, etc., were identical for both procedures.

TABLE 1

PERCENTAGE PENICILLIN FOUND BY ASSAY

Blood preparation	Paper disc method	Oxford cup method
Defibrinated rabbit blood	97.6	33.5
Oxalated rabbit blood	92.0	39.0
Rabbit serum	89.5	66.6

The initial concentration of penicillin for each of the blood preparations was 320 units/ml. Oxalated blood was prepared by adding 2 mg. of $K_2C_2O_4 \cdot H_2O$ to each ml. of blood.

The results of a typical assay are given in Table 1.

It will be observed that in every instance the results obtained by the Oxford cup method were low, whereas the values by the paper disc method were comparatively satisfactory. The slight losses in the latter case possibly may be due to a destructive action of the blood upon the penicillin. Such an action has been demonstrated by Bigger (*1*) and confirmed by us. We have found that blood containing penicillin solutions, when allowed to stand for a week or 10 days at refrigerator temperatures, suffered losses as high as 60 per cent as revealed by the paper disc technique. Thick paper discs under these circumstances appeared to be less reliable than those cut from thin filter paper.

Similar discrepancies between the disc and the cup technique were observed when dog blood was used instead of rabbit blood. E. T. Reese, of the J. T. Baker Chemical Company (personal communication), also has found that the disc method gives higher results than the cup method on samples of fermentation medium, but that the methods are in agreement on samples of commercial penicillin.

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A Simple Method for Studying Friction

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A spring which obeys Hooke's law has one end fastened to a horizontal plane and the other end fastened to a body so that displacement of the body along the plane produces a horizontal restoring force in the spring. When there is sufficient displacement to produce a restoring force of greater magnitude than the maximum static frictional force between the body and the plane, and the displacing force is then removed, the spring will move the body back along the plane. The body will continue in this motion until the kinetic frictional force exerted on the body by the plane absorbs all of the kinetic energy given to the body by the restoring force of the spring.

If the kinetic frictional force above is the only force which absorbs energy while the block is moving under the spring's influence, the time rate at which the energy is absorbed will be the same as that at which the sum of the potential and kinetic energies is decreasing in the system, since this is a nonconservative system. Thus, $f\frac{dx}{dt} = \frac{d}{dt}\left(\frac{1}{2}mv^2 + V(x)\right)$, where $V(x)$ is the potential energy of the spring and $\frac{1}{2}mv^2$ is the kinetic energy of the body. Since all of the kinetic energy is absorbed by the kinetic frictional force and since the restoring force of the spring is linear, the magnitude of the kinetic frictional force will be equal to the average of the restoring forces acting on the body while it is in motion after one given displacement. (Integrating both sides of the above equation for the interval $x_2 - x_1$, over which the body moves after a given displacement, since the velocity is zero at the beginning and end of the interval, gives $f = \frac{1}{2}(F_1 + F_2)$, where F_1 and F_2 are the restoring forces of the elongations x_1 and x_2 of the spring.)

This offers a very simple classroom method for measuring kinetic friction when a block slides on a horizontal plane. A spring balance is used as the spring. The sliding frictional force

may be determined by displacing the block along the plane until the spring-balance force is large enough to slide the block backwards upon removal of the displacing force. A reading of the spring balance should be taken at this point. Another reading is taken after the displacing force is removed and the block has stopped sliding. (The maximum restoring force should not be so great as to give a minimum restoring force of less than zero.) The arithmetical mean of the two corrected spring-balance readings is equal to the magnitude of the average restoring force and hence will be equal to the magnitude of the sliding frictional force. In determining the coefficient of sliding friction where the change in the frictional force for a given change in normal force is used, it is not necessary to correct the spring-balance readings, since the corrections would subtract to zero.

This method may also be applied in studying the friction of a body moving on an inclined plane. In this case, the average spring-balance reading would include the component of the weight of the body along the plane.

Thermostated Cell Compartment for the Beckman Spectrophotometer

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The Beckman Spectrophotometer, as furnished by the manufacturer, is quite useful for the study of any rate process involving a spectral change. However, since most mechanism studies depend on quantitative reaction-rate measurements, thermostating of the reacting solutions in the instrument becomes essential.

Preliminary research on penicillin had shown that marked changes of ultraviolet absorption took place during its chemical degradation. These experiments indicated clearly that the acid degradation forming penillic acid from penicillin was quite complicated, with one or more conjugated intermediates existing in the solution during the reactions. Because of the large amount of effort being spent on determining the structure of penillic acid, a careful study of the mechanism of its formation from penicillin was made.[1] The temperature control necessary for this complex study was obtained by the thermostated cell compartment described below.

The construction and outward physical appearance of the Beckman Spectrophotometer should be familiar to anyone interested in this report, and therefore detailed description is not necessary. The compartment described is designed to replace the sample holders furnished with the instrument. The solvent balancing feature of the instrument requires that a solvent cell as well as the sample cell be moved into the light beam. This is accomplished by moving the thermostating jacket containing the cells back and forth inside the light-tight compartment which is rigidly attached to the spectrophotometer.

The actual compartment in a partly dismantled condition is shown in Fig. 1. In Fig. 2, scale drawings are shown, with an accompanying legend giving the essential details of the construction. The main frame, thermostating jacket, pipes, guides, cell holder, and screws are all of brass. (The most important of these are indicated by crosshatching.) Other parts, such as the inside and outside plates forming the dead-air spaces in top, bottom, and ends, plates on both sides, slide handle, and the light-tight sliding door in the top, are constructed from bakelite.

The optical system of the spectrophotometer uses a spherical mirror in an off-axis position to focus the monochromatic

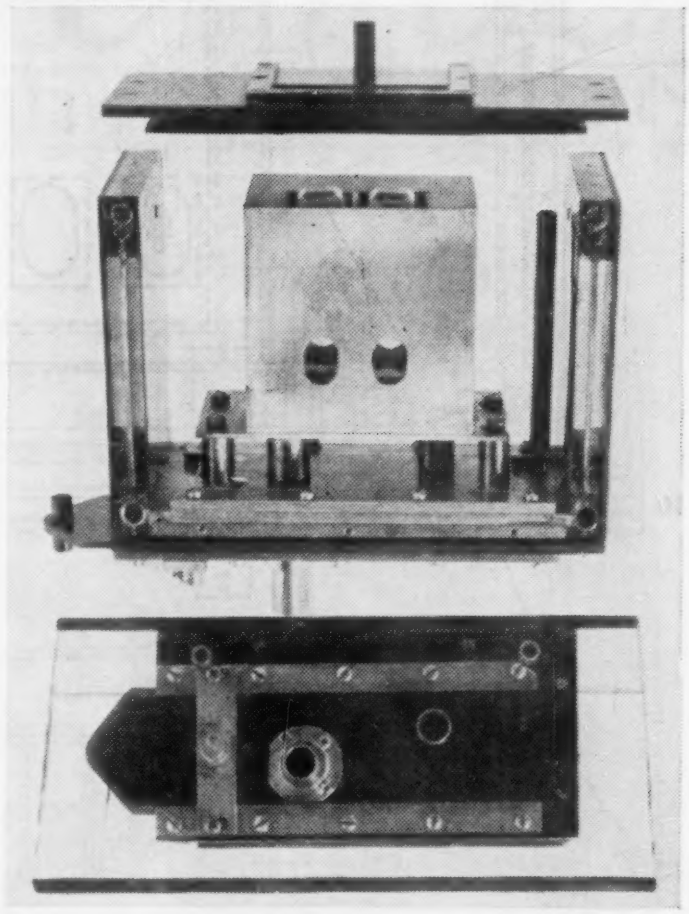

FIG. 1. Thermostated cell compartment with sides removed and the top in an exploded position, and a mirrored view of the bottom.

light on the exit slit. This arrangement gives a divergent exit beam, the dimensions of which are shown by (1) and (13). The position for the absorption cells was chosen where this beam was nearly square in shape, making it possible to use cells with the same sample thickness but completely blocking the beam with only 0.5–0.75 cc. of solution. The space occupied by the cells (8) is located at one side of the water jacket to keep as small as possible the distance between the cells and the photocell detector. This feature minimizes the errors due to light scattering from the cells and solutions.

Since this equipment was designed to be useful several degrees above or below room temperature, certain insulating features were necessary. By the use of multiple walls, the dead-air spaces (5) were created. Also, the compartment was insulated from the spectrophotometer and the phototube compartment by bakelite plates with only small openings for the light beam. If the cell compartment was being maintained at a temperature much below that of the room, the problem of frosting of the absorption cell windows had to be overcome. To do this, space was allowed for desiccant, and drying gas

[1] The results of this work were reported at the Atlantic City meeting of the American Chemical Society, April 8–12, 1946, and will be published shortly.

ports (4) were provided. In order to keep the compartment from taking in damp air when the cells were being withdrawn or inserted through (6), the clearance between the movable water jacket and the top was kept as small as possible.

The water jacket, inside sliding plate (14), and the sliding handle (10) are held together by the liquid tubes (2 and 3).

Using thermocouples, immersed in the liquid contained in the absorption cells (4 cc. each), temperature measurements were made to test the efficiency of thermostating. The thermostating liquid was supplied by an American Instrument Company Refrigerated Constant Temperature Bath and passed through the compartment at a rate of 1 gallon/minute.

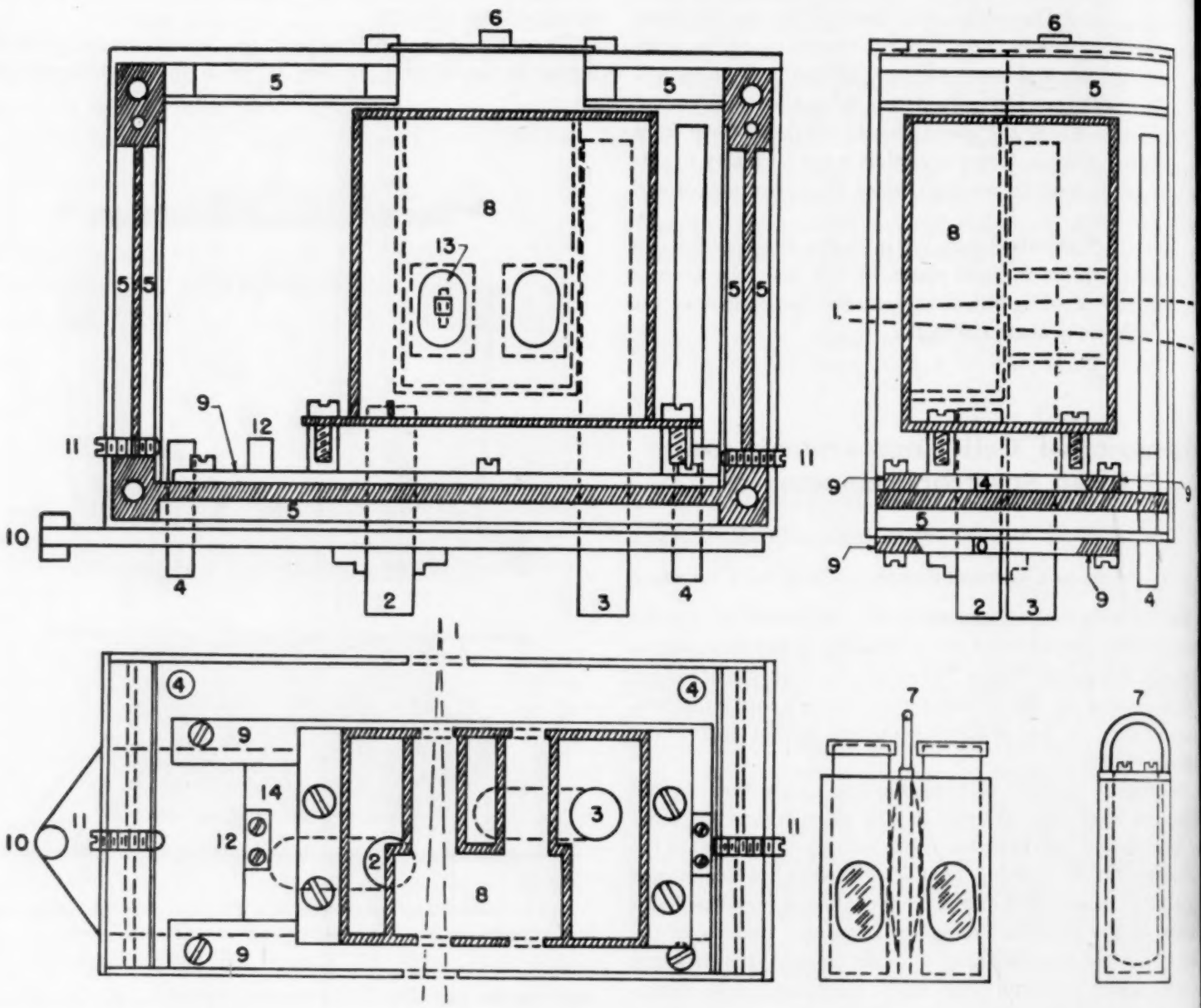

FIG. 2. Scale drawing of thermostated cell compartment.

(1) Light path from spectrophotometer
(2) Thermostating liquid inlet
(3) Thermostating liquid exit
(4) Drying gas ports
(5) Insulating dead-air spaces
(6) Sliding light-tight cover
(7) Cells and cell holder
(8) Space for cell holder in thermostat
(9) Guides for the movable plates carrying the thermostat
(10) Sliding handle
(11) Adjustment screws for limiting horizontal motion
(12) Bumper for adjustment screw
(13) Position and shape of light beam
(14) Sliding supporting plate

This unit can move within the guides (9), since openings are provided in the brass bottom and the bakelite plate forming the bottom air space, to accommodate the movement of the tubes (2 and 3). The supporting plate (14) and the sliding handle plate (10) cover these slots at all times, thereby maintaining the dead-air space (5) and keeping the entire compartment light tight.

Starting with the solutions at room temperature, approximately 10 minutes was necessary to obtain thermal equilibrium. At the highest temperature tested (76°C.), less than a 0.5°C. drop was observed between the bath and solutions in the thermostating compartment. This thermostating arrangement has been tested and used from 5°C. to 76°C. and found to give very satisfactory temperature control.